DOCUMENT RESUME

ED 317 883 CG 022 395

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|---|---|
| TITLE | Appropriate Technology for an Aging Society. Critical Debates in an Aging Society Report 1. |
| INSTITUTION | American Society on Aging, San Francisco, CA. |
| PUB DATE | Nov 87 |
| NOTE | 35p.; A report based on the Technology and Aging Conference (Washington, DC, November 17-18, 1987). |
| PUB TYPE | Reports - General (140) |
| EDRS PRICE | MF01/PC02 Plus Postage. |
| DESCRIPTORS | Aging (Individuals); *Appropriate Technology; Futures (of Society); Health Services; *Individual Needs; *Older Adults; Quality of Life; *Technology |

ABSTRACT

Despite a real sense of need, the development and application of technology for the elderly has progressed very slowly. This report explores reasons for this slow progress; examines how the process can be moved along; looks at what must be known about aging and the future to assure appropriate technological application; considers how to translate the need for technological innovations into suitable products and assistive devices for the elderly; identifies the most vital steps to be taken by business leaders, technologists, and gerontologists; and determines what technologies are particularly critical. In addition, the report provides specific suggestions for using technology to meet the aging population's needs. Individual sections focus on the slow progress in using technology to aid the elderly, the elder market, applying technology to older people's needs, demographics, the context for studying technology and aging in the future, what it means to grow old, and limitations in daily functioning and their effects. The report concludes that the successful use of technology in improving health care and enhancing the quality of life for older people will depend on simplicity, training, considering the whole person, enhancing maximum independence, aiding caregivers, caregiving at home, evaluation, and funding. The appendix provides a detailed examination of specific physical and other changes which may occur as part of the aging process. A selected bibliography is included. (NB)

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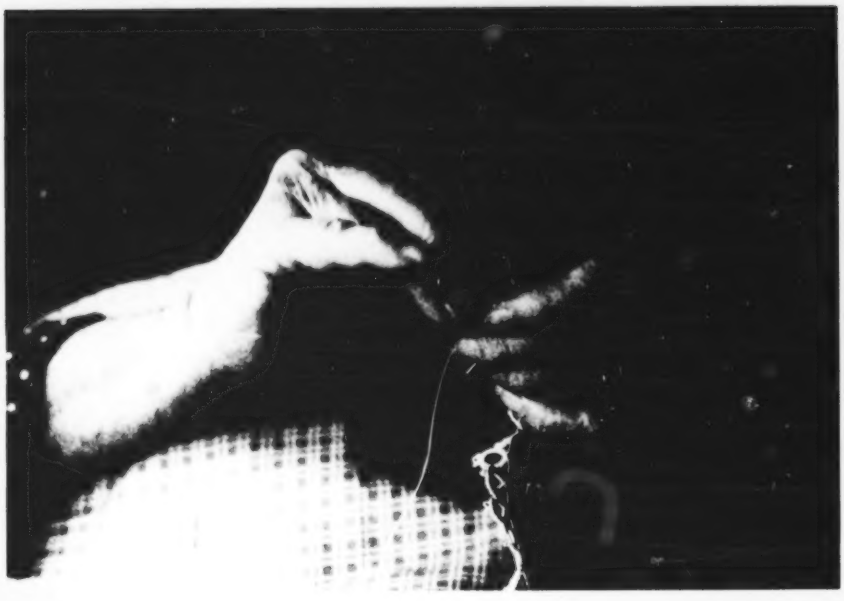
# PPROPRIATE TECHNOLOGY FOR *an Aging Society*



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*Critical Debates in an Aging Society - Report 1*

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# THE AMERICAN SOCIETY ON AGING AND THE NATIONAL FORUM ON TECHNOLOGY AND AGING

he American Society on Aging (ASA) with over 7,000 members is the largest professional organization in the field of aging. Recognition of the need for and the barriers to appropriate technological application for an aging population led the ASA Board of Directors to establish the National Forum on Technology and Aging in 1986. The Forum links together the disparate groups which must be involved if its agenda -- to apply technology systematically to meet elders' needs -- is to move forward. The Forum's goals are to:

- Broaden the commitment to working in the field of technology and aging and guide the focus of participants' activities;
- Analyze and provide timely information about the needs of the consumer and the caregiver today and in the future, and define the place of technology in meeting those needs;
- Identify the values that should govern the development and dissemination of technology;
- Based on these needs and values establish priorities for work in the field;
- Define the language and the field itself so that the coalition of consumers, gerontologists, technologists, businesses and others can communicate more effectively and work together to solve problems;
- Identify the barriers to advancement and develop strategies to overcome them.
- Train consumers and care providers about the value and use of technology for continued independence.

To move the process in this direction, Forum members determined that activities which focus the work of the growing number of committed, multidisciplinary participants were essential. A Strategic Planning Retreat was the first step, followed by a Conference on Technology and Aging. The information contained in this Report is based on these convenings and relevant background information.

*A Report Based on*
*THE TECHNOLOGY AND AGING CONFERENCE*

November 17 - 18, 1987
Washington, DC

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# INTRODUCTION

Although complex and costly technologies have emerged in the last 50 years, simpler devices for individual use -- tools for living -- have also been developed. These aids help sustain an acceptable quality of life for older people and others with disabling conditions who wish to avoid dependency. When combined with necessary personal care services and other adaptive strategies, these devices ease the impact of disability and simplify daily living.

Despite a real sense of need and evidence of continued interest, the development and application of technology for the old has progressed very slowly. The following questions require attention:

- Why has progress been so slow?
- How can the process be moved along?
- What do we need to know about aging and the future to assure appropriate technological application?
- How do we translate the need for technological innovations into suitable products and assistive devices for the elderly?
- What are the most vital steps we can take -- as business leaders, technologists, and gerontologists?
- What technologies are particularly critical?

This report will explore these questions and provide specific suggestions for using technology to meet the aging population's needs.

***...development and application of technology for the old has progressed very slowly.***

Present research on aging shows that people will be living longer and continuing to work past present-day retirement ages. The need for improved devices which help older people maintain independence is growing. Work environments also need to be redesigned to accommodate elderly people. Technology can play an important role in improving healthcare and enhancing the quality of life for older people. Success will depend on the following factors:

### Simplicity

There is a great need to solve commonly experienced problems. Many of them can be relieved by applying "simple" or "low" technology. Until now most resources have gone into developing emergency and life-sustaining devices. This emphasis should be changed so that technology can serve more individuals.

### Training

Training physicians, healthcare providers, caretakers and elders is crucial, both to the acceptance of innovative technology and for its successful implementation. Training can increase awareness of the availability and benefits of innovations, as well as assure their appropriate use.

### Considering the Whole Person

Technological innovations which serve the elderly must be designed with the mind, body and attitude of the elder in mind. It should be recognized that elders' physical, mental and social abilities and needs directly influence their ability to benefit from an innovation.

### Maximum Independence

Technological devices which enhance independence support one of the most important values of older adults. They help increase elders' self-esteem and also reduce caregivers' practical tasks, freeing them to engage in more sustaining and emotionally supportive activities.

### Aiding Caregivers

Innovations are needed which aid healthcare providers. Whether in an institution or at home, the burden on healthcare providers is great. Technological innovations can ease this work, provide the elder with more independence and increase the time available to caregivers.

### Caregiving at Home

It is valuable, both in terms of cost and enhanced independence, to develop innovations which elders and caregivers can use at home or in a nursing home. Innovations which are miniaturized, reliable, self-monitoring and portable will increase the use of those technologies which currently must be used in a hospital setting.

### Evaluation

Innovations need to be carefully evaluated for suitability. It has been found that the most reliable evaluations happen over time and take into consideration changes occurring in the elder's environment.

### Funding

At the national level it must be assured that Medicare, Medicaid and related co-insurance policies recognize the benefits of technological innovations and declare them reimbursable. At present, reimbursement for technological innovations which can be used outside of an institutional setting is generally not available.

# PROGRESS SLOW IN USING TECHNOLOGY TO AID ELDERLY

## Technological Response to Elderly People's Needs

Instead of rapid progress in the development and application of technology, our nation has only ambiguously, tentatively and partially responded to the social and health needs of the chronically ill, areas where simpler assistive devices are most important. And when we have developed technologies to assist elderly people, we have focused almost entirely on the individual instead of the environment, and on piecemeal solutions rather than a comprehensive response. Furthermore, technology is often ignored as a viable component of care plans. This neglect occurs for two primary reasons:

1. Reimbursement to the consumer is rarely available to cover the costs of much-needed technologies.

2. Care providers are inadequately informed about the potential of technical aids.

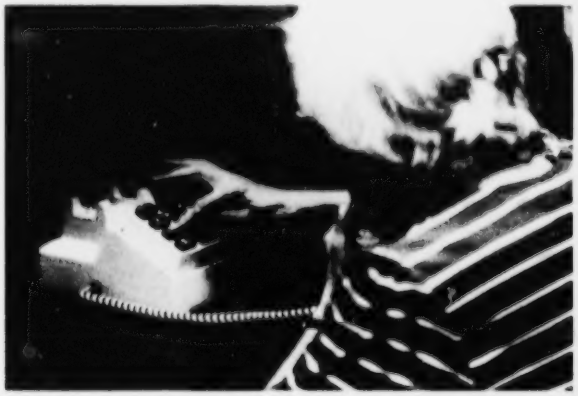
## Reasons for Slow Progress

In addition to these broad impediments, there are other reasons for slow progress in applying technology to aid the elderly, namely:

- Appropriate goals for technological application, especially in human services, are only vaguely understood.

- High-technology items (e.g., CAT scanners) dominate resources, partly because they relate directly to life and death cases and also because they provide significant technological challenges.

- Communication barriers divide the producers and users of technology.



**Need to Overcome Barriers**

Until consumers, business managers, marketers, technologists, scientists and human service providers share information and work toward commonly accepted goals, elders will remain only marginal users of technology. However, the need to overcome these barriers will grow significantly in the years ahead for the following reasons:

1. The number of old people -- especially the very old -- will increase as the 21st century approaches.

2. Cost and preference will generate a need to support older people in their own homes.

3. A potential labor scarcity will challenge our entire society's ability to meet the long-term care needs of this aging population.

Technology will become increasingly vital to sustaining much desired individual autonomy.

***...need to overcome these barriers will grow significantly in the years ahead...***

# THE ELDER MARKET

## Studies on the Elder Market

In 1985, the Administration on Aging funded a national study on the product needs of older Americans. The Gallup organization conducted the survey, which was published by Martek Associated in Portland, Oregon. Since then, the National Association of Senior Living Industries has developed its own report entitled the "LAVOA Study" (Lifestyles and Values of Older Adults). More recently, the Daniel Yankelovich Group, Inc. prepared a report for the Markle Foundation entitled "Aging in America: Current Themes and Future Directions." A similar report issued by the Chicago-based firm, Goldering and Company, Inc., is entitled "The Geromarket: An Extra Close Up View of the 50 and Over Market." All of these studies indicate that, although the older market is still emerging, its importance to those who manufacture and disseminate technology has not been lost.

## The Increasing Elder Market

For many businesses, successfully developing and marketing to older individuals may be a new venture. It is one worth pursuing, however, since the elder market is steadily increasing in size and economic importance. Although the older population is at least as heterogeneous as any other market segment, there is no doubt that the needs of this group for specialized technology will grow.

Products designed with the older consumer in mind are often functional for all age groups. For example, handles and latches designed for easy use by elders' stiff hands are also easier for everyone to use.

## Marketing to Older People

In targeting products for the elder market, some recent insights and observations should be kept in mind:

- Elders do not wish to be stereotyped as frail, senile or old-fashioned.
- It is advantageous to try to reach the potential elder consumer directly with product information.
- Quality products at reasonable prices are particularly valued.
- Elderly people prefer an upbeat approach to marketing -- especially for products designed to help solve unpleasant problems.
- On the average, older generations have a higher percentage of disposable income than any other age group. But extremely wide discrepancies between those with the highest and those with the lowest incomes also characterize this group.
- Caregivers should also be considered part of the elder market, since products aimed at increasing elders' quality of life frequently improve the caregivers' ability to care for them.

## The Caregiver Market

When older consumers are under consideration, caregivers become an important secondary market. One example of this interrelationship is the care needs of "wandering" people (e.g., elders with certain types of chronic cognitive disorders such as Alzheimer's disease tend to wander). Until recently, these elders either had to be continually observed or restrained in some way. The advent of electronic monitoring devices permits the elder more freedom, reduces the amount of time invested in observation and lowers the stress on caregivers. In this case, as with many other chronic care situations, the caregiver, rather than the care recipient, identified the need, and benefits significantly from the product's use.

## Incentives to Stimulate Supply and Demand

Incentives to stimulate market demand would be useful in all efforts to make the market more attractive to product developers. Such incentives include:

- Limited tax credits for disabled people
- Government-backed guaranteed loans
- Broader third-party coverage

Improving consumers' ability to purchase products can increase market demand. However, it is important that products not be rushed into the marketplace because of the availability of subsidies. Adequate testing and then training and service support for products must back up their diffusion.

***...advent of electronic monitoring devices permits the elder more freedom, reduces the amount of time invested in observation, and lowers the stress on caregivers.***

***Adequate testing and then training and service support for products must back up their diffusion.***

# APPLYING TECHNOLOGY TO OLDER PEOPLE'S NEEDS: WHAT TO CONSIDER

## *1. The Interactive Process*

**What is it?**

The interactive process facilitates information exchange among key parties involved in designing, producing and using products and environmental modifications. This process is essential because effective communication among all parties involved in needs assessment and technological product development insures effective transfer and use of technology and technological products. The interactive process helps answer questions such as the following:

1. How can products and environments be developed so that they work effectively for the end-user?

2. How can we facilitate communication among all parties involved in needs identification, technological development, evaluation and application?

3. What are the key value, cost and access questions around the transfer of technology, and how do we construct appropriate technology transfer models?

4. How can we design a process whereby product developers can communicate directly with end-users?

When the interactive process is used to answer these questions, all parties involved benefit -- businesses, older consumers and research organizations.

**Businesses Benefit**

Businesses can develop new products and enter the market with reduced risk of failure if they have shared information with other groups. They can be assured that consumers will have reviewed their products before investing resources to manufacture and distribute their product or service. Businesses will be more confident knowing that new products have an increased chance of successfully meeting the consumer's needs, and that they will be marketed in a way that appeals to older consumers.

**Consumers Benefit**

For older consumers, the successful development and use of technology is equally important. Effectively developed products, services and environments will improve their quality of life, assisting them and their caregivers in meeting the challenges of aging. For example, a product dealing well with the problem of incontinence allows the elder to leave his or her home without fear of embarrassment. Such a product increases life options, supports continued autonomy and independence, and improves the quality of the elder's life. It is therefore important for older adults and their helpers to work in partnership with businesses and other organizations involved in product development.

***The interactive process facilitates information exchange among key parties inolved in designing, producing and using products and environmental modifications.***

***...important for older adults and their helpers to work in partnership with businesses and other organizations involved in product development.***

### Research Organizations Benefit

By working with businesses and consumers, research organizations are able to assure that the results of their research are effectively applied to provide the maximum societal benefit. The interactive process also gives research organizations the background information essential for focusing their efforts on serving the elderly and recognizing possible linkages between needs and research choices.

### Involving Older Consumers in Product Development

Older consumers are particularly well suited to assist those who wish to use the interactive process in developing products for other older consumers. Organizations which have involved the older consumer have discovered that they provide excellent assistance. They have significant experience in using and evaluating products and, at the same time, are anxious to share their discoveries about effectiveness.

## *II. Methods for Collecting Consumer Input*

In collecting consumer input, traditional market research tools are useful, as is statistical information describing the needs and demographics of the older market (see THE DEMOGRAPHIC PICTURE in this report). In addition, more active research methods are available.

### Senior Groups

Focus groups designed to include older individuals or service providers can be most helpful in considering a new product. Also, despite some research design disadvantages (smallness of group size and its non-representative population characteristics), senior discussion groups are inexpensive and useful. These groups, composed of individuals who usually gather for other purposes at locations such as senior centers, can discuss needs or new products successfully and inexpensively.

### Advisory Groups

Companies may also seek consumer input through a consumer relations approach. This method generally involves standing or *ad hoc* advisory groups who provide advice and evaluation of ideas and products. Standards formation groups can also be developed when new products come under consideration. Some organizations establish permanent consumer boards for these purposes.

### Technical Research

This approach uses groups of professionals (such as service providers) to provide advice and assistance around the study of a particular problem or issue. At other times, think-tanks are formed. These groups are composed of professionals, who are asked to develop or evaluate products or approaches. In some organizations, advisory groups have been formed with a mixture of employees and external experts.

### Advocacy Groups

In the advocacy group approach, businesses contact national advocacy and/or consumer groups, such as the American Association of Retired Persons (AARP). These organizations are frequently able to provide or recommend individuals to serve as advisors in the development of products and services.

### Contacting Consumers

Consumers or end-users are also very important in the final effort to market products. Companies should make every effort to locate the potential market directly, not only through appropriate advertising and exhibits, but through product demonstrations.

### Advantages and Disadvantages of Consumer Involvement

All of these approaches are relatively inexpensive and simple to arrange. They offer excellent methods of collecting consumer input in the design and marketing of products. They are not, however, trouble free. Research of this type can often be time consuming. In some organizations the involvement of consumers may appear controversial. However, several large corporations and utilities have successfully used these methods to secure valuable input in the marketing of their products. Without a doubt, consumer involvement can help assure a product which addresses the needs of those to be served.

## *III. Form, Fit and Function*

The standard phrase, "form follows function," must be expanded to meet the challenges of a changing populace. Products and environments must be developed from an understanding of the function, the demands for fit, and the desire for aesthetic form. For instance, many would suggest that the function of a hearing aid is to amplify sound for an individual with impaired hearing. This explanation is true, but incomplete. The function of a hearing aid is to enhance communication by enabling the wearer to hear wherever he or she goes.

### How Hearing Aids Fail the Form, Fit and Function Test

The hearing aid is one example of a common technological failing. At present only 13 percent of all hearing impaired persons (20 percent of them elderly people) own a hearing aid and many individuals who own them do not use them. Why is this?

The form of the modern hearing aid is compact; it is available in several flesh colors, and fits neatly into the ear. The hearing aid is custom fit to match the ear, with the wearer's need determining its acoustic qualities. The function is to selectively amplify those sounds which the wearer cannot hear. Since these devices are custom molded, typical problems with fit (frequently experienced with other products) are avoided. How do hearing aids fail to be as useful and important as they can and should be?

The hearing aid industry has focused solely on the ear and hearing in considering its design. As a result, the manual adjustment dials on the hearing aid are very small -- too small for many individuals with restricted hand movement to use. Thus, the form may be perfect for the ear, but not for the wearer.

This weakness is a common example of problems which many products and environments face when developed for a single purpose without proper attention to the environmental problems they will acutally encounter. If the product is difficult to use and does not function in many environments, its utility is compromised.

### Why Form is Usually Considered First

Industries' primary concern for most new products is the form. Determining the form is often driven more by competition than by the needs of product users. Because of this, the interactive process can be very useful for assuring responsive and therefore usable products.

### Failure in Total Functional Capabilities

Many products and living environments fail to consider the potential user's total functional capabilities. For example, the design of orthopedic cane handles or stair railings is based on shape and grip tests of just one model hand. The design features rarely permit adaptation to individual needs, emphasizing function for individuals with vastly different capacities. It is time to design products with an emphasis on their basic function, so that adjustment to individual needs is possible.

**Guidelines for Improving Form, Fit and Function**

- **The product or environment must function fully to sufficiently meet the need and demand for it.**

  For example, the hearing aid must not just amplify sound, it must also be designed so that users can open it to insert batteries, insert the batteries properly, turn the hearing aid on, adjust the volume control and use it in a sea of noise.

- **The product or environment cannot be functional unless it fits the abilities of the user.**

  The hearing aid must not just fit the contours of the user's ear, it must be compatible with manual dexterity, visual capabilities, memory and understanding.

- **Only after function and fit requirements are met should form be determined.**

  Designers have a dual challenge: to accommodate the functional and fit demands and create a product of high aesthetic quality.

- **Products should be marketed without stigma.**

  Items which address older people's disabilities can be presented as products of convenience for everyone, not just for the elderly or disabled.

- **Products need to be evaluated extensively.**

  Extensive evaluation insures that products genuinely meet the needs of their users. The user may have multiple problems which interfere with their ability to function in their community or at home. The design of products should consider possible cognitive as well as multiple functional losses.

- **Technological advances should be taken advantage of.**

  Advances in computerization, miniaturization, communications and materials are beginning to make it feasible for equipment which was formerly restricted to hospital use to be operated at home.

## *IV. Healthcare Technology*

The healthcare environment provides many opportunities for technological intervention and advancement. There is a great need for simple innovations that will help with everyday living tasks, in addition to current sophisticated life-sustaining equipment. A visit to a hospital's intensive care unit will provide a vivid display of advanced technology used to sustain life. From measuring blood gases to renal dialysis, almost all of these technological marvels depend on the administration of trained technicians within a healthcare institution. Many of them are extremely expensive and can help only a small number of people.

### Assistive vs. Life-Sustaining Devices

A significant question our society will have to address is how much of our scarce resources should be allocated to developing these sophisticated and costly life-extending technologies. In a recent book entitled, *Setting Limits: Medical Goals in an Aging Society*, author Daniel Callahan suggests we refrain from targeting federal research dollars for such technological development. He believes we should concentrate on enhancing their quality of life, instead of lengthening elders' life spans. Even if one does not support Callahan's views, the need for simpler, assistive technical devices is clear.

### Technological Applications Which Enhance the Quality of Life

What devices or aids can enhance the lives of those who do not require life-sustaining efforts, but who need help managing chronic conditions and living independently? What technological advances are possible to fit into a home or community, rather than an institutional setting? A technological wish list of this sort might include devices designed to:

- Prevent elders from injuring themselves;
- Enhance ease of bathroom use;
- Provide feeding assistance;
- Improve medication technologies;
- Address problems related to incontinence.

The latter is particularly important, since incontinence is currently the single most common reason for institutionalizing elderly people.

### Developing Healthcare Technology

When considering the development of technology for use in the healthcare setting, several factors require attention:

- The older person using the innovation;
- The elder's physician supporting the product's use;
- The caregivers assisting the elder;
- The environment in which the innovation will be used.

***There is a great need for simple innovations that will help with everyday living tasks, in addition to current sophisticated life-sustaining equipment.***

## Older Consumers' Considerations

*Self-confidence and motivation:*
The self-confident elder who is motivated to utilize a particular innovation will normally derive many more benefits from the product than those who lack self-confidence and motivation. This suggests the need for training, encouragement and ease of use.

*Convenience of the product:*
If a device is inconvenient to use, it is much less likely to be utilized, especially over a long period of time. The amount of training received by the user and the caregiver can make a significant difference in how convenient the product is. Training is frequently underemphasized in disseminating new technologies, even though undertrained elders and caregivers are much less likely to use the innovation correctly. The amount of support a person receives from family, friends and caregivers in utilizing a particular innovation can also influence its successful use.

*Interaction of the product with other aspects of the elder's life:*
A particular innovation which elders use in combination with other technologies or medications can reduce or totally cancel the potential benefits from that innovation. Hence, producers of technologies must have a good understanding of the potentially complex interactions of the innovation and other factors relevant to the conditions it is addressing.

## Physicians' Considerations

Given the typical, though changing, relationship between patient and physician, it is important that the physician both feel and express his or her support that the device is in the patient's best interest. The physician's level of knowledge and training regarding the various technological innovations or devices will clearly influence whether they recommend products to their patients.

Many physicians hesitate to recommend technological devices for use outside institutions because all risk cannot be eliminated. To provide a simple illustration, the use of a walker may make an older person more mobile and independent, but might expose the elder to additional risks found in their expanded environment. The physician's attitude toward the frail elder's independence influences the use of technological devices designed to promote independence. In general, the more cautious the physician, the less independence afforded the elder.

## Caregivers

An excellent way to address these imposed limits is to involve the patient and the caregivers in the choice between independence and safety. Particularly with frail and disabled elders, caregivers are instrumental in successfully utilizing technological innovations. Knowledge of new products' potential benefits must become part of routine care planning if technology is to be fully utilized.

The amount of training care planners receive about innovations and their attitude toward technology are significant factors in acceptance, since caregivers -- professional and non-professional -- can be greatly assisted by technology. Technological innovation can simplify the caregiver's job and save valuable time.

## Environmental Considerations

Particular technological innovations must function in environments which complement the innovation's successful application. Medications being taken, limits in patient's activity or physical ability and limitations on the space in which the innovation is being used are all part of this environment. Although many environmental issues can be anticipated, it is impossible to recognize them all, especially since they are often not immediately evident. These facts makes the ongoing evaluation of a particular innovation's effectiveness with a particular elder most important.

# THE DEMOGRAPHIC PICTURE: TODAY AND TOMORROW

## A Demographic Overview

Although demography is not necessarily destiny, an idea of who the old are and how they live is an important first step in informing the producers and distributors of technological devices about the consumer population. This section gives information about the present elderly population and some probable future trends.

- Today, more than 24 million Americans are over 65 and 20 million are between 55 and 64.
- By 2000, 31 million Americans will be over 65 and 23 million will be between 55 and 64.
- By 2010, one out of four Americans will be over 55 and one in seven will be at least 65.
- By 2050, one in three Americans will be 55 and older and one in five will be 65 plus.

**2000**
**31 Million Over 65**
**23 Million (55 - 64)**

**TODAY**
**24 Million Over 65**
**20 Million (55 - 64)**

**2050**
**1 Out of 5 Over 65**
**1 Out of 3 (Over 55)**

**2010**
**1 Out of 7 Over 65**
**1 Out of 4 (Over 55)**

**Facts About America's Aging Population**

- **The fastest growing segment of American population is the very old – people over 85 years of age.**

  By the year 2000 there will be approximately 5.2 million men and women in this country who are over 85.

- **Home will emerge as the dominant site for healthcare.**

  This change -- growing old at home instead of in institutions -- will accelerate as the educational level, political acumen and economic status of the elderly continue to rise. Home is an ideal location for technological intervention. Such intervention might become the critical factor in maintaining an elder's relative independence, when faced with a shortage of healthcare workers who will challenge current service modes.

- **Over one-third of all older Americans (8.8 million) live alone, of which 80 percent are women.**

  Roughly 2.6 million are widows who are poor or near-poor, surviving on incomes of less than $156/week, and the numbers will only grow in the decades ahead. The social and economic implications of this fact are enormous. For these women, who face increased morbidity brought about by chronic illness, technological intervention can support independent living. Yet, their relatively low income levels may make it financially difficult, or even impossible, for them to obtain those assistive devices which already exist, without financial support.

- **Future demands for labor and increased uncertainty about retirement income mean older people will most likely continue working past age 65.**

  The article, "Desperately Seeking Workers," in *Nation's Business* reported that the 1965-79 birth rate decline is already creating labor shortages. It appears that new labor sources will need to be tapped -- and the older worker is one of the most significant sources. With increased hiring or rehiring of older workers, the implications for technology will be significant. The workplace must be carefully adapted to respond to age-related changes. From modular furniture to modified lighting and wholly redesigned offices, technology will make it possible for a significantly extended worklife.

***From modular furniture to modified lighting and wholly redesigned offices, technology will make it possible for a significantly extended worklife.***

# CONTEXT FOR STUDYING TECHNOLOGY AND AGING IN THE FUTURE

## Older People's Place in Society

In this last decade of the 20th century, American society is facing a period of frantic social and economic change in which memories appear to be irrelevant and nothing is valued more than youth and adaptability. The following questions must be asked to determine older people's place in this society and how we can make their lives more comfortable:

1. If we live to increasingly advanced ages, how will this change affect our society and the way the aging live their lives?
2. Even if we do not live longer, what are some changes that the future might bring?

## Values and Technology

If technology is to become a comfortable, supportive part of an elder's life, three questions emerge:

1. What is the appropriate relationship of the individual to technology?
2. How can we assure equitable access to technological devices?
3. What is the relationship between technology and human caring?

Most importantly, technology must value the centrality of the individual. Three additional values are significant:

1. On the personal level, technology must be balanced with human caring and traditional services.
2. Acute and chronic care must also be balanced.
3. Equitable access to the products of technology must be assured.

If technology is to become a significant force in the lives of older Americans, it must become fully accepted as a credible, desirable intervention, and Medicare, Medicaid and other third party payors need to reimburse users for technical aids.

## Envision the Future

By envisioning what the future may look like and placing in it anticipated health status and other characteristics, we can build a framework for researching technologies and developing products. However, we must be prepared for surprises; no one can know the future entirely, since we are in the process of creating it right now.

***...technology must value the centrality of the individual.***

***If technology is to become a significant force in the lives of older Americans, it must become fully accepted as a credible, desirable intervention, and Medicare, Medicaid and other third party payors need to reimburse users for technical aids.***

### Social Change

Arthur Shostak, a futurist, predicts that we will remake the world in the next quarter century and that this transformation will occur in an environment of dramatic demographic shifts. In addition to the gradual aging of the population, people will become increasingly robust. More elders will remain in the workplace; they will travel more and be actively involved in politics. As a result, Shostak predicts that we will see new legislation such as support for euthanasia, respite care, and perhaps polygamy and polyandry. Household forms may change with more voluntary or companionate families.

### Economic Change

Economic change will parallel social change. The shift to high-technology manufacturing will be completed. Today 23 percent of workers are "making things;" by the year 2010 only 5 percent will be producing goods. New employment areas will emerge: the space industry will grow, fusion will probably be available for commercial uses, and new trains and hydroplanes will appear on the landscape. People will not only be working in new areas, they will also work shorter hours. Sabbatical years, life-long job training and rapid shifts in job responsibilities will take place.

### Class Structure Change

Another trend is already apparent, namely the end of the middle class. American class structure will undergo a major reconfiguration as the middle-middle class disappears. Recent census data already suggest that extremes of wealth are accelerating.

### Life Stage Changes

Traditional views of the life cycle suggest that particular life events occur with considerable predictability at certain ages. Today, the lines between life stages are blurring and new ones are forming. The generation now old is the first to experience a long retirement. This may be a passing phenomenon as we move to multiple retirement experiences and second, third and even fourth careers. This means that education will become a recurrent learning process -- it will no longer be odd for a 50-year old woman to begin law school. Adult learning modes will be developed which integrate computers and feature experiential learning and direct feedback.

### Norms for a Meaningful Old Age

These changes call for a serious re-examination of norms and expectations of what constitutes a meaningful old age. If the world is to be hospitable for the new old, it must respond by finding ways to maintain older persons at all levels of human experience -- the biological, sociological, psychological and spiritual. No aspect of being human can be neglected.

***...we will remake the world in the next quarter century and this transformation will occur in an environment of dramatic demographic shifts.***

***Adult learning modes will be developed which integrate computers and feature experiential learning and direct feedback.***

# WHAT DOES IT MEAN TO GROW OLD?

## Aging and Disease

Although aging affects the entire human organism, the aging process does not automatically bring disease. Changes in sensory and intellectual functioning, diminished mobility and decreased physical strength are often age-related, yet they are not absolute correlates of age.

Susceptibility to disease does increase with age, but elderly people have remarkable abilities to adapt to change. Unlike people experiencing sudden physical changes resulting from a catastrophic accident, the aging person has time to accommodate to their body's changes. Any number of technological interventions -- often the simplest, sometimes the most sophisticated -- can ease adaptation to physical changes.

## Functional Disabilities Among the Elderly

Estimates of functional limitations among older persons range from 20-46 percent, with increasing age the essential variable.

- 50 percent of elders over 85 experience some degree of limitation.
- Only 4 percent are seriously disabled.
- The leading causes of activity limitation in 1982 were arthritis, hypertension, hearing impairments and heart conditions.

Limitations often only minimally interfere with full and productive lives, and self-assessment of health status remains overwhelmingly positive.

## Mental and Emotional Problems

In addition to physical limitations, mental and emotional problems frequently are unrecognized and therefore untreated. The following graph shows the correlation between age and cognitive impairment:

Under 75
1 percent

75 - 84
7 percent

85 +
25 percent

### How Society Views Aging People

Although older people perceive themselves as relatively unchanging, it becomes harder and harder for them to ignore the reactions of others. Combined with other problems identified with old age, a strong sense of self becomes difficult to sustain. Older individuals often "become" what they perceive others expect of them. Particularly for older women, this experience results in behavior that is more limiting than their physical capacity indicates, especially in new or unfamiliar environments.

The term "learned helplessness" describes this phenomenon. By trying to eliminate all risk or by seeking to alleviate the burden on caregivers, professionals or family members often protect the older persons as they would a young child. In the process, the elder may lose the ability to make choices and decisions commensurate with their physical and mental capacities. Again, technology can be a very non-intrusive protector without infantilizing the elder. Aided by effective advertising, technology can transform a negative problem (e.g., incontinence) into a situation with a positive solution.

***Older individuals often "become" what they perceive others expect of them.***

# LIMITATIONS IN DAILY FUNCTIONING AND THEIR EFFECTS

## Activities of Daily Living (ADLs)

Different physical and mental changes associated with aging affect older people's ability to carry out the activities of daily living in their own homes and in the community. The extent to which a person can dress, prepare meals, bathe, walk, get in and out of bed and go to the toilet is often the key to continued independence. Home management activities -- shopping, handling money, driving, using public transportation, and doing house and yard work -- are also important. There have been a number of national efforts to identify the ways in which technical aids and industrial and environmental design can be useful in assisting with these activities.

## Accidents

Accidents are the eighth leading cause of death among people over 65, and they also often threaten continued independent living. Although inability to manage home activities is not the sole cause of accidents among the elderly, it probably is very significant. Here again technological intervention is critically important. Carefully conceived product and environmental design can reduce the accident rate and insure independence. Such attention should also result in designs which are supportive for all users.

***The extent to which a person can dress, prepare meals, bathe, walk, get in and out of bed and go to the toilet is often the key to continued independence.***

**The Challenges of Daily Living**

In a Gallup survey of non-institutionalized people over 55, most respondents identified the following as problems:

- Opening medical packages
- Reading product labels
- Reaching high things
- Fastening buttons, snaps and zippers
- Vacuuming and dusting
- Going up and down stairs
- Cleaning bathtubs and sinks
- Washing and waxing floors
- Putting clothes over one's head
- Putting on shoes, socks and stockings
- Carrying purchases home
- Using tools
- Fearing accidents with no one there to help
- Using the shower or bathtub
- Tying shoelaces, bows and neckties
- Moving around the house without slipping and falling

Though many of these activities seem obviously simple and not absolutely necessary for everyday living, consider the dramatic changes in life and the threat to independent living when it is no longer possible to complete a number of the activities listed. According to noted literary critic and octogenarian, Malcolm Cowley, the message that one is old comes in several different ways, one being when it becomes an achievement to do thoughtfully, step by step, what one once did instinctively. Technology can provide the necessary assistance to insure the aging population's continued independence.

# *APPENDIX A*
# PHYSICAL AND OTHER CHANGES AND THE AGING PROCESS

## Information from Research

Research, which seeks to specify needed capabilities to perform certain tasks, is increasingly available from human factors engineers and others. Also being developed are measures of: 1) anthropometric variables describing the dimensions and configurations of the human body; 2) biomechanical variables describing motions, applications of force and other dynamic physical aspects of human performance; and 3) psychological or cognitive variables describing memory, vigilance, eye-hand coordination, decision-making and control-display utilization.

## Information Input

The following sections will examine, in greater detail, specific changes which often occur as part of the aging process.

*Sensory Processes:* Sensation allows us to become aware of stimuli through the exteroceptive systems, more commonly known as eyes, ears and tastebuds. Perception is the interpretation and integration of sensations and patterns of sensations. With increased age there is a general decline in both sensory and perceptual abilities. In contrast to younger people, older people are often handicapped because they acquire less information, or less accurate information, or take more time to extract the same information, or make some sense of the information about the world as younger people.

*Vision:* A precipitous decline in acuity typically occurs beyond age 50 and by age 70. Without correction, poor vision is the rule rather than the exception. Acuity affects the ability to discriminate detail and to perform tasks such as reading or inspection. There are a variety of reasons for this loss of acuity such as retinal decay, reduction in pupil diameter, opacities and bubbles in the lens and vitreous humour and loss of lens elasticity. In addition to these "normal" changes, diseases such as macular degeneration may cause changes, and so may diseases of the vascular, metabolic or endocrine systems. Such deterioration affects the person's ability to read the newspaper, enjoy TV, sew, appreciate art, etc.

Other losses include:

- Decreased powers of accommodation (difficulty in adjusting to changes in viewing distance, which means that it takes longer to "see" something);
- Decreased powers of dark adaptation;
- Decreased contrast sensitivity (problems in distinguishing target from background);
- Increased sensitivity to glare;
- Reductions in the visual field;
- Some loss of color sensitivity, especially in the blue/green end of the color spectrum;
- Light absorbed more by the retina (which results in less light available for seeing).

*Audition:* There is some loss of auditory acuity with age. The degree of loss depends, to some extent, on the exposure to noise throughout life. Of elders in the general population, we can anticipate that from the age of 65-74, 231 out of 1000 will have some hearing loss; from 75 and over, that number increases to 399 per 1000. Six million people over 65 have sufficient bilateral hearing loss to warrant consideration of hearing aids, yet only 21 percent use them.

The loss in hearing ability which accompanies advanced age is commonly referred to as presbycusis. Presbycusis is a syndrome that is characterized by: 1) loss of sensitivity to sounds in the high frequency range; 2) impairments in speech discrimination; 3) decreased ability to understand distorted speech; 4) decreased ability to recall long sentences.

The causes of presbycusis may be associated with sensory, neural, metabolic or mechanical changes in the older person's hearing system. The precise manifestations will depend on the particular type of presbycusis involved in a given case, and these manifestations will be highly variable in sensitivity. What we do not know is how mild or moderate decrements in auditory functioning affect daily life.

As the future comes to depend more and more on synthetic speech and speech recognition systems, we will need to determine how the hearing impairments of age affect use of these systems, and how they can be designed to compensate for any hearing and associated losses.

It is also possible that other factors such as response cautiousness, attentional lapses, slowed reaction time and decrements in short term memory interact with sensory changes to produce decrements in auditory performance. Understanding how these factors interact may be one of the critical keys to designing appropriate interventions.

The impact of hearing loss, although often hidden, may be particularly profound. It may result in a gradual estrangement from family and friends and, for some, may result in premature institutionalization.

*Touch:* As the mass and sensitivity of the skin to touch changes, it may affect fine touch capabilities, and perhaps pose safety risks because of reduced sensitivity to stimuli such as heat. Tremors affect the ability to place the hand in positions of safety and reliability when there is any weight, and even when there is no weight. Factors associated with grip strength (see page 26) affect fine touch. Additionally, tremors or loss of arm and wrist strength can affect the sensory feedback systems, which are required to position a control or accomplish a complex manipulative task. Joined with losses in visual acuity, there may be interruptions in the feedback loops required for eye-hand coordination.

*Perception and Cognition:* One of the reliable findings regarding aging and cognition is a reduction in perceptual speed. This slowness is the result, in part, of a decline in the information processing rate, which results in slower reaction time. There is still controversy as to why this change in the nervous system accounts for the greatest portion of psychomotor slowness in the elderly. To be clear about the definition, reaction time is the time between the onset of a stimulus and the initiation of a response -- it is an index of mental processing time as it reflects stimulus identification and response selection. Yet, like many other age-related changes, factors other than age influence the magnitude of the change. The nature and familiarity of the task and health status are also important. Further, older people put a great premium on accuracy, which may result in a slower reaction time. Nonetheless, this age-related slowness in reaction time is of considerable practical importance. It contributes to difficulties in operating vehicles or equipment or responding to changes in system events. It has an effect on performance problems, can create stress on highly paced tasks and contribute to higher accident rates.

**Information Processing, Memory, Intelligence and Learning Skills:**

*Information Processing:* With age, we note increased difficulty in dealing with confusing or complex stimuli, such as selecting target information in the presence of irrelevant stimuli. As situations become more complex in either their stimulus or response modalities, older people process information more slowly.

*Memory:* We also observe a decline in memory functioning. What must be made clear, however, is that the declines are slow, and vary greatly among individuals. In addition, research information is far from conclusive, especially in the area of memory. What does seem clear is that "failing memory" does not necessarily characterize older people, and that the real world consequences for everyday behavior of most types of forgetting are less severe than is true of information processing, decision-making and responses made under the pressure of time. Pathological memory failure and other forms of serious disturbances in intellectual functioning are relatively rare in the population.

*Intelligence:* Post-World War II research has comfortably laid to rest the idea that general cognitive decline is an essential element of chronological aging. The changes are more in the manner in which information is handled and the speed with which it is processed.

Different types of intelligence may decline differently. For example, learned intellectual skills (crystallized intelligence) are far more stable than more fluid intelligence such as the ability to adapt to new situations, discover new relationships or acquire new ideas. In fact, continued improvement in the use of previously-learned material is not at all uncommon. Information about the world, comprehension, ability to make judgments, arithmetic and vocabulary remain remarkably stable over time. These changes have implications for learning. It means that old people may take longer to learn new skills and that traditional methods of training which rely on rote memorization are inappropriate.

## Physiological Changes

*Stature:* As a result of anatomical and postural alterations, older people are shorter in stature than younger adults. Sitting height also decreases, as does functional arm reach. A major problem is the lack of task-related anthropometric data which specify the extent to which reduced stature along a given dimension actively affects a specific task sequence.

*Physical Agility and Flexibility:* In terms of functional relevance, declines in physical agility and flexibility, such as those accompanying arthritis, can be more important than declines in strength and stamina. A 70-year old woman can probably live quite independently even if she can't walk ten miles or lift heavy boxes; however, her independence may be threatened if she can't turn handles or unscrew jar tops.

*Biomechanics:* These conditions relate specifically to an area known as biomechanics. In terms of whole body movement, biomechanical changes include loss of muscle mass, osteoarthritis, which affects joints, and general levels of stamina relevant to maintaining a postural orientation for any length of time. Task related impacts are several; for example, biomechanical changes will affect reaching, bending, or standing at storage or work areas necessary for food preparation. The ability to make postural changes and maintain balance is likely to be reduced, thus making the use of stools and other devices potentially risky modes of adaptation.

*The Biomechanics of the Hand:* Changes in the biomechanics of the hand are an important area for consideration in product and environmental design. Home environments and technologies often present demands for strength and dexterity which are in excess of the capabilities of older persons. The general losses observed in the musculoskeletal system (mass loss) also affect the strength of wrist and hand. The gradual onset of bone or joint disease, particularly osteoarthritis, can affect required levels of dexterity long before the older person or the health care provider recognize the existence of any pathology.

In terms of the biomechanics of the hand, there are several major areas of change in the older adult that can be related to product development and use. These include: grip strength, the manipulation of various weights or imparting motion under load, and fine touch. Although the amount of research has been limited, a sample of older women (who have not yet displayed any impairments in carrying out the tasks of daily living) indicated that they had less than half the grip force of younger women.

**Interactions and Limitations**

Among the old, the variety of conditions described above tend to occur in combinations, rather than singly. Declines in sensory function occur along with declines in physical function, and their limiting effects multiply. These interactions are of concern for several reasons. One is that elders themselves may be less aware of some limitations because of declines in sensory or intellectual function. Therefore, they may be unaware of the extent of a problem or problems, or be unwilling to make the efforts necessary to address it or them. The other is that assistive or technological devices that have been developed to help younger people with a specific disability are often inappropriate or ineffective for older persons with multiple limitations.

*Impact on Task Performance:* Even mundane tasks can become problems when interactions of disabilities occur. In a focus group, one older woman observed that she did not take her medication as often as she should because the labels were all alike and nearly unreadable with her failing eyesight. Futher, the "childproof" tops were so difficult for her to unscrew that if the first one had the wrong color pills, she often didn't bother to struggle with opening any more. Her comments were followed by another participant who noted that while she could open her medications with minimal difficulty, she couldn't remember whether or not she had already taken them. While most intellecutal abilities do not decline with added years, short term memory, as described above, does become a problem for many people.

*Compounded Losses:* Sensory losses can compound other problems. For example, if one's gait has become less steady, limitations in vision and hearing can make getting around, especially in unfamiliar places, a frightening and potentially hazardous experience. Walls and floors of the same color with no differential border between them make it easy to trip when walking nearer to the wall, as frequently done by those needing support. Patterns in floor tiles can look like obstructions and glass walls like doors, for those with reduced vision and depth perception.

*Relationship to Need for Assistance:* For all these reasons, more older people report that they need help in continuing to live independently than the data on physical functioning suggest. For persons over 65, 6 percent of those between 65 and 74 reported needing help in activities involved with home management, such as shopping, chores, or handling money. For persons 75 to 84, 15 percent reported needing regular help, and for those 85 and older, 40 percent needed help with at least some of these activities. Many cannot be helped with technological devices. Their needs are too great for less than hands-on contact. Yet, there are many who could continue to perform the tasks of daily living with the help of technological devices. Additionally, there are elders who report no difficulty in performing a task but who would welcome any simplification or lesser effort that might result from using an innovation developed for the marginally able.

The greatest problems are in less familiar territory. Three times as many elders reported needing help outside their homes, in the neighborhood and beyond, as reported needing help within their own homes. People can and do make adaptations, large and small, that allow them to continue living independently, but most of the adaptations they report are in the nature of curtailing or limiting options, rather than finding alternatives that permit options to continue.

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*Many of the references listed in this bibliography have been excerpted from *Technology and Aging in America*, U. S. Congress Office of Technology Assessment. U. S. Government Printing Office: 1985 0-47-732, Washington, DC.

*Publication of this Report was made possible by a generous grant from the Pacific Telesis Foundation.*

*The American Society on Aging is particularly pleased to acknowledge the Foundation's commitment to this work and the staff's consistent encouragement and support.*

*It also wishes to acknowledge and thank Pacific Bell for its vigorous and sustained support - in so many ways - throughout the work on this Report.*

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